



# Certificate of Analysis

## Standard Reference Material<sup>®</sup> 3191

### Aqueous Electrolytic Conductivity

Lot No. 050403

This Standard Reference Material (SRM) is intended primarily for use in electrolytic conductivity measurement as a calibration standard or control sample. As a calibration standard, it can be used to determine the conductivity cell constant. One unit of SRM 3191 consists of one glass bottle containing approximately 500 mL of solution. The solution was prepared by dissolving reagent grade potassium chloride (KCl) in deionized water in equilibrium with atmospheric carbon dioxide.

SRM 3191 was prepared gravimetrically using deionized water that was filtered through a 0.22  $\mu\text{m}$  filter. The initial electrolytic conductivity of this water was less than 0.2  $\mu\text{S/cm}$ . The solution was dispensed into borosilicate glass (Pyrex<sup>®</sup>)<sup>1</sup> bottles. The certified electrolytic conductivity and its uncertainty given below were established through determinations with a conductivity cell immersed in a constant temperature oil bath and using a Jones bridge with a null detector. The conductivity bridge and electronics are described in references 1 and 2.

The certified value given below is based on equilibrium conditions, and the solution should **NOT** be degassed before use. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or accounted for by NIST [3].

Electrolytic Conductivity at 25.000 °C: 99.43  $\mu\text{S/cm}$   $\pm$  0.28  $\mu\text{S/cm}$

The uncertainty in the certified value,  $U = 0.28 \mu\text{S/cm}$ , is calculated as

$$U = 1.96 u_c$$

where  $u_c$  is the combined standard uncertainty calculated according to the ISO and NIST Guides [4]. The value of  $u_c$  is intended to represent, at the level of one standard deviation, the combined effect of major uncertainty components associated with the dissolution of carbon dioxide, stability of the SRM, and the cell calibration. All other uncertainty components are insignificant. The value of  $u_c$  has been multiplied by 1.96, which is the coverage factor corresponding to approximately 95 % confidence based on greater than 1000 overall effective degrees of freedom.

**Expiration of Certification:** The certification of **SRM 3191 Lot No. 050403** is valid, within the measurement uncertainty specified, until **22 February 2007**, provided the SRM is handled in accordance with instructions given in this certificate (see "Instructions for Use" section). This certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

This SRM was prepared and analyzed by K.W. Pratt of the NIST Analytical Chemistry Division.

Stephen A. Wise, Chief  
Analytical Chemistry Division

Gaithersburg, MD 20899  
Certificate Issue Date: 14 June 2006  
*See Certificate Revision History on Last Page*

Robert L. Watters, Jr. Chief  
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<sup>1</sup>Certain commercial equipment, instruments, or materials are identified in this certificate in order to specify adequately the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Statistical consultation was provided by W.F. Guthrie of the NIST Statistical Engineering Division.

The support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

**Maintenance of Certification:** NIST will monitor representative solutions from this SRM lot over the period of its certification. If substantive changes occur that affect the certification before the expiration of certification, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

Conductivity is strongly influenced by temperature, and for this solution, the temperature coefficient at 25 °C,  $\alpha$ , is approximately 2.0 % per °C [5]. The certified value and its uncertainty were determined with the temperature at 25.000 °C  $\pm$  0.005 °C. The corresponding equation for correcting to other temperatures is

$$\kappa = \kappa_{25^{\circ}\text{C}} [1 + \alpha(t - 25^{\circ}\text{C})]$$

where  $\kappa_{25^{\circ}\text{C}}$  is the certified value,  $\alpha$  is 2.0 % (= 0.020),  $t$  is the temperature of measurement, and  $\kappa$  is the corrected value at  $t$ . This correction is valid in the range of  $t = 25.0^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ . It should not be applied to values of  $t$  outside this range.

## INSTRUCTIONS FOR USE

The SRM bottle should be open for the minimum time required to dispense the solution. Each time the bottle is opened, a portion of the solution will evaporate, which will change the conductivity. After use, the bottle should be tightly recapped and stored under normal laboratory conditions away from acid fumes, nitrogen oxides, and sulfur dioxide. These precautions will reduce the evaporation rate of the solute and possible acidic contamination.

## REFERENCES

- [1] Shreiner, R.H.; Pratt, K.W.; *Primary Standards and Standard Reference Materials for Electrolytic Conductivity*; NIST Special Publication 260-142, U.S. Government Office: Washington, DC (2004).
- [2] Wu, Y.C.; Pratt, K.W.; Koch, W.F.; *Determination of the Absolute Specific Conductance of Primary Standard KCl Solutions*; J. Solution Chem., Vol. 18, p. 515 (1989).
- [3] May, W.; Parris, R.; Beck, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136, U.S. Government Printing Office: Washington, DC (2000); available at [http://ts.nist.gov/ts/htdocs/230/232/SP\\_PUBLICATIONS/documents/p260-136.pdf#search='NIST%20Special%20Publication%20260136'](http://ts.nist.gov/ts/htdocs/230/232/SP_PUBLICATIONS/documents/p260-136.pdf#search='NIST%20Special%20Publication%20260136').
- [4] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st ed., International Organization for Standardization: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297, U.S. Government Printing Office: Washington, DC (1994); available at <http://physics.nist.gov/Pubs/>.
- [5] Robinson, R.A.; Stokes, R.H.; *Electrolyte Solutions*; 2nd ed., p. 89, Butterworths: London (1959).

<b>Certificate Revision History:</b> 14 June 2006 (Update of expiration date and editorial changes); 15 June 2005 (Original certificate date).
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*Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/srm>.*